NASA GLDAS Evapotranspiration Data and Climatology

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AMS January 2012
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Introduction

Evapotranspiration (ET) is the water lost to the atmosphere by evaporation and transpiration. ET is a shared component in the energy and water budget, therefore, a critical variable for global energy and water cycle and climate change studies. However, direct ET measurements and data acquisition are difficult and expensive, especially at the global level. Therefore, modeling is one common alternative for estimating ET.

With the goal to generate optimal fields of land surface states and fluxes, the Global Land Data Assimilation System (GLDAS) has been generating quality-controlled, spatially and temporally consistent, terrestrial hydrologic data, including ET and other variables that affect evaporation and transpiration, such as temperature, precipitation, humidity, wind, soil moisture, heat flux, and solar radiation.

This poster presents the long-term ET climatology (mean and monthly), derived from the 61-year GLDAS-2 monthly 1.0°x1.0° NOAH model Experiment-1 data, and describes the basic characteristics of spatial and seasonal variations of the climatology. The time series of GLDAS-2 precipitation and radiation, and ET are also discussed to show the improvement of GLDAS-2 forcing data and model output over those from GLDAS-1.

GLDAS Data

- More than 30 years (Jan. 1979 – present) GLDAS Version 1 (GLDAS-1) output data, from the CLM, Mosaic, NOAH, and VIC models.
- More than 60 years (Jan. 1948 – 2008) GLDAS Version 2 (GLDAS-2) output data, from the Noah model. Data from the CLM, Catchment, and VIC models are coming soon.

Motivation of GLDAS-2

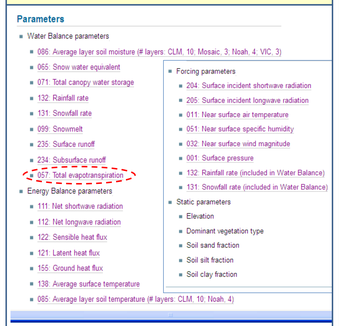
- To create more climatologically consistent data sets, using the Princeton forcing data sets and upgraded land surface model (LSM) versions.

Major Differences between GLDAS-1 and GLDAS-2

- GLDAS-2 is extended back to 1948, using the Princeton forcing data sets.
- There are two streams of simulations:
  - Princeton-based, from 1948 up to 2008.
  - Observation-based, from 2001 to present.
- There are multiple experiments.

GLDAS Basic Characteristics	
Content	Water and energy budget data, forcing data
Spatial coverage	All land north of 60° South
Spatial resolution	0.25° and 1.0°
Temporal coverage	Version-1 1.0°: Jan. 01, 1979 - present 0.25°: Feb. 24, 2000 - present Version-2 1.0° : Jan. 01, 1948 - 2008
Temporal resolution	3-hourly and monthly
Forcing	Multiple data sets derived from satellite measurements and atmospheric analyses
Land surface models	CLM, Mosaic, NOAH VIC
Output format	GRIdded Binary (GRIB)
Elevation definition	GTOPO 30
Vegetation definition	University of Maryland, 1 km

GLDAS Parameters



http://disc.sci.gsfc.nasa.gov/hydrology/data-holdings/parameters

More Info: http://ldas.gsfc.nasa.gov/gldas/ http://disc.sci.gsfc.nasa.gov/hydrology

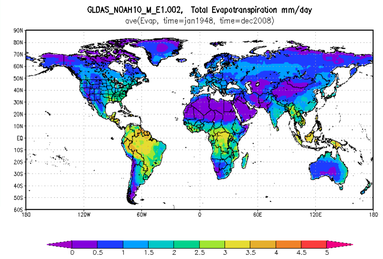
GLDAS is supported by the NASA Energy and Water cycle Study (NEWS).

Evapotranspiration Climatology

Data: GLDAS-2 Noah Model Experiment 1 Monthly 1.0°x1.0°

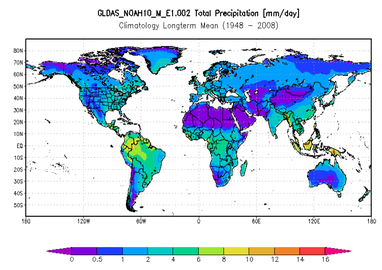
Computation Method:

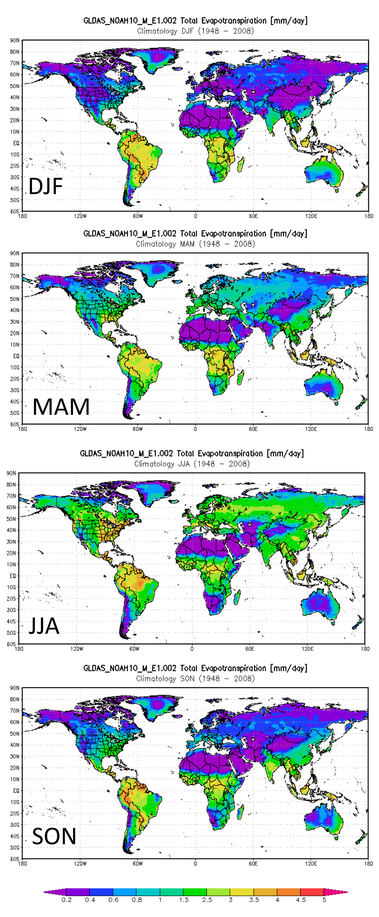
- **Mean Map:** Simple temporal average, by using GrADS ave() function
- **Time Series:** Simple areal average, by using GrADS aave() function



61-year Long-term Mean

Long-term mean (1948 – 2008) map of Total ET (right-upper) shows high ET areas centered on Amazon Rainforest, Africa Woodland, and eastern United States and low ET areas centered on Sahara Dessert and Gobi Desert. The global mean ET shows good spatial correlation with the precipitation (right-lower).



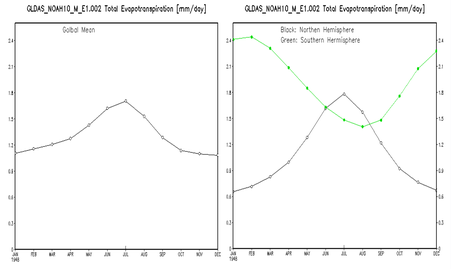


Seasonal Climatology

Total ET shows clear seasonal cycle, effected by solar radiation. The seasonal means (1948 – 2008) show relative low ET in Northern Hemisphere winter (DJF) and relative high ET in Northern Hemisphere Summer (JJA). Spring (MAM) and fall (SON) show two transitional seasons, with major differences in Eurasia.

Global Mean Annual Cycle

Global mean ET annual cycle (below-left) is dominated by Northern Hemisphere contribution (below-right, black line), in both intensity and phase, as expected, because major landmasses are located north of the equator. However, the Southern Hemisphere ET annual cycle (below-right, green line) shows much larger amplitude and slightly shifted phase.

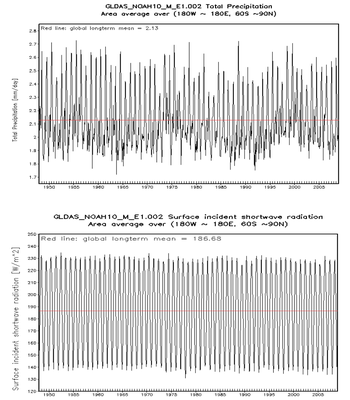


Improvements to GLDAS-2 Data

Improved Meteorological Forcing Data from Princeton University

Princeton Forcing data set (Sheffield et al., 2006) provides near-surface meteorological data for driving land surface models and other terrestrial modeling systems.

The global mean time series of Total Precipitation (rainfall + snowfall, right-upper) and Surface Incident Shortwave Radiation (right-lower) show 61-year temporally consistent data.

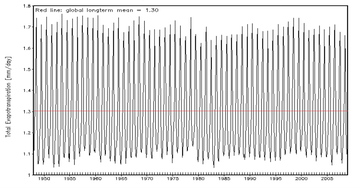


Improved GLDAS-2 Model Data

In GLDAS-1, source of forcing data was changed several times during the 30-year data record. As a result, model output data show some discontinuities corresponding to dates of forcing data changes. GLDAS-2, using the improved forcing data from Princeton, has generated 61 years of improved and climatologically consistent data, using updated LSMs.

Global mean time series of Total ET (right) shows the improvement of the 61-year consistent intensity and annual cycles.

Other variables (not shown here) of GLDAS-2 model outputs also show improved data consistency.



Summary

- To date, GLDAS-2 has generated more than 60 years (1948 – 2008) of output from the Noah model, using the Princeton forcing data set as input. Output from the CLM, Catchment, and VIC models will be available soon.
- 61 years of Total ET of GLDAS-2 Noah 1° x 1° monthly Experiment 1 shows clear annual cycle and good spatial correlation with Total Precipitation.
- GLDAS-2 shows good consistency over the 61-year period of the intensity and annual cycle of global mean Total ET.
- These quality-controlled, spatially and temporally consistent terrestrial hydrological data could play an important role in characterizing the spatial and temporal variability of water and energy cycles and, thereby, improve our understanding of land-surface-atmosphere interactions and the impact of land surface processes on climate extremes.
- All data are accessible at NASA GES DISC Hydrology Data Holdings via Mirador, ftp, GDS, or Giovanni, http://disc.sci.gsfc.nasa.gov/hydrology/data-holdings .
- Monthly climatology data could be incorporated into Giovanni GLDAS Monthly Portal, thereby facilitating analysis of anomalous events and trends.

GLDAS Primary References

Rodell, M., P. R. Houser, U. Jambor, J. Gottschalck, K. Mitchell, C.-J. Meng, K. Arsenault, B. Cosgrove, J. Radakovich, M. Bosilovich, J. K. Entin, J. P. Walker, D. Lohmann, and D. Toll, The Global Land Data Assimilation System, Bull. Amer. Meteor. Soc., 85(3): 381-394, 2004.

Sheffield, J., G. Goteti, and E. F. Wood, Development of a 50-yr high-resolution global dataset of meteorological forcings for land surface modeling, J. Climate, 19 (13), 3088-3111, 2006.